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09/321,518	05/27/99	GILTON	6047-51973
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EXAMINER

SOUW, B

ART UNIT

PAPER NUMBER

2814

DATE MAILED:

10/18/00

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.
09/321,518

Applicant(s)
Gilton et al.

Examiner
Bernard Souw

Group Art Unit
2814



☒ Responsive to communication(s) filed on Aug 23, 2000

☒ This action is **FINAL**.

☐ Since this application is in condition for allowance except for formal matters, **prosecution as to the merits is closed** in accordance with the practice under *Ex parte Quayle*, 35 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire 3 month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claim

☒ Claim(s) 1-56 is/are pending in the application.

Of the above, claim(s) 1-38 is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) 39-56 is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐ approved ☐ disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☒ None of the CERTIFIED copies of the priority documents have been
☐ received.

☐ received in Application No. (Series Code/Serial Number) _____.

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

— SEE OFFICE ACTION ON THE FOLLOWING PAGES —

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DETAILED ACTION

Restriction/Election

1. Applicant's election without traverse of claims 39-46 (Apparatus claims) in Paper No. 4 is acknowledged. The restriction requirement is therefore made **FINAL**.

Acknowledgment

2. The amendment A filed 08/23/2000 (paper no. 4) under 37 CFR 1.111 in response to the Office Action dated 03/08/2000 has been entered.

The provisional phone-cancellation of non-elected claims 1-38 has been confirmed.

Claims 39, 42, 44, and 46 have been amended.

New claims 47-56 have been added.

The present Office action is made with all the suggested amendments being fully considered. Therefore, pending in this Office action are claims 39-56.

35 U.S.C. 103 (a) Rejections

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was

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made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 39-41, 46, 48, 50, 51, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over limuro et al. in view of Hawthorne et al. (JP-01234933) (5,785,875)

limuro et al. disclose an apparatus shown in Fig.1 for cleaning semi-conductor wafers 3, the wafers 3 having first and second wafer side surfaces, the apparatus comprising:

- a chamber (1/2/11) sized to receive at least one wafer 3 to be cleaned, as shown in Fig.1, consisting of cylindrical container 1, lid 2, and sealing element 11;
- a solvent applicator 12/13/6/7/8 coupled to the chamber 1/2/11 and adapted to vaporize and apply a solvent to at least one of the first and second side surfaces of the wafer 3 positioned within the chamber 1/2/11 so as to form a film of liquid solvent on said at least one of the first and second wafer side surfaces;
- a temperature controller 4 positioned and operable to maintain the at least one wafer at a temperature equal to or lower than about a dew point of the solvent, as shown in Fig.1 and recited in the Constitution;
- a gas source 15 of at least one reactive gas coupled to the chamber 1/2/11 so as to deliver such gas to the chamber (through applicator 6/7/8), the at least one reactive gas being selected to chemically react with the surface of the wafer to clean the wafer, as shown in Fig.1 and recited in the Constitution; and wherein

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- the liquid solvent comprises a transport medium (water vapor) which carries at least some of the at least one reactive gas (ozone) through the film (by means of diffusion, as known to one of ordinary skill in the art) to said at least one of the first and second wafer side surfaces where at least one reactive gas chemically reacts with said at least one of the first and second wafer side surfaces, as recited in the Constitution, lines 8-11.

However, Iimuro et al. do not explicitly recite that the solvent (water steam) forms a film of liquid solvent on the wafer surface 3, and that the temperature controller 4 maintains the wafer at a temperature equal or lower than the dew point of the solvent.

Although not explicitly recited, temperature controller 4 maintains the wafer at a temperature equal to or lower than about a dew point of the solvent (which is a function of the vapor pressure), as known to one skilled in the art from the P-T diagram of water vapor, whereby the water "steam" as recited in the Constitution, lines 3-4, is generally understood in the art as being at a temperature/pressure lower than the dew point of water in the conventional P-T diagram for water, which is understood by one of ordinary skill in the art as to condense to form liquid water film, either by increasing the pressure, and/or lowering – i.e., cooling down -- the wafer temperature, as is generally known from the P-T diagram.

Although the above Official Notice is sufficient to render obvious Applicant's claim, as a courtesy the Examiner can here present Hawthorne et al. as a further/secondary prior art not necessarily required.

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Hawthorne et al. disclose an apparatus shown in Figs.1 and 2 for cleaning semiconductor wafers 12, the wafers 3 having first and second wafer side surfaces, the apparatus comprising:

- a chamber 10 sized to receive at least one wafer 12 to be cleaned, as shown in Figs.1-2, and recited in Col.4/ll.39-43;
- a solvent applicator 22 coupled to the chamber 1/2/11 and adapted to vaporize and apply a solvent to at least one of the first and second side surfaces of the wafer 12 positioned within the chamber 10, as recited in Col.5/ll.29-37, so as to **form a film of liquid solvent** on said at least one of the first and second wafer side surfaces, as **explicitly recited** in Col.5/ll.33-35;
- a temperature controller positioned and operable to maintain the at least one wafer at a temperature equal to or lower than about a dew point of the solvent, as inherently understood in Hawthorne's specification, since in order to **form a film of liquid solvent** on the wafer surface, as **explicitly recited** in Col.5/ll.33-35, the temperature must be controlled and maintained equal to or lower than about a dew point of the solvent, as conventionally known in the art from the P-T diagram for the solvent;
- a gas source 22 of at least one reactive gas coupled to the chamber 1/2/11 so as to deliver such gas to the chamber (through applicator 6/7/8), the at least one reactive gas being selected to chemically react with the surface of the wafer to clean the wafer, as shown in Figs.1-2 and recited in Col.5/ll.29-31; and wherein

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- the liquid solvent comprises a transport medium which carries at least some of the at least one reactive gas through the film (by means of diffusion, as known to one of ordinary skill in the art) to said at least one of the first and second wafer side surfaces where at least one reactive gas chemically reacts with said at least one of the first and second wafer side surfaces, as recited in Col.5/ll.32-34.

It would have been obvious to one having ordinary skill in the art at the time of the invention to build an Apparatus for cleaning semiconductor wafers according to limuro's, thereby applying the solvent so as to form a liquid film on the wafer, since a liquid film has much more intensive contact with the wafer surface to be cleaned, thus enhancing the efficacy of the cleaning process, as generally understood by those having ordinary skill in the art, even in the absence of any specific teaching or suggestion from Hawthorne et al.

- Regarding claim 40, the limitation that at least one reactant gas is introduced to the solvent prior to forming the film of liquid solvent, is disclosed by limuro et al. in Fig.1, showing a generator 15 introducing reactant gas into the solvent evaporator 13 within the mixing container 12.
- Regarding claim 41, limuro's generator 15 shown in Fig.1 produces ozone as reactant gas, and container 13 in Fig.1 contains water.
- Claim 46 differs from claim 39 only by the recitation of condensing the vapor to form a liquid film by **cooling** the surface of the wafer. It is a general knowledge in the art that condensing a vapor, as implicitly understood in limuro's and explicitly recited by

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Hawthorne at al. in Col.5/ll.33-35, to form a liquid film can be achieved either by increasing the pressure and/or cooling the temperature, as can be easily discerned from the corresponding P-T diagram for any solvent.

In the event the Applicants would insist that Hawthorne's teaches **away** from Applicants' present disclosure (i.e., Hawthorne's process moves **away** from the dew point towards the gas phase in the corresponding P-T diagram), Applicants would be seriously advised to acquire the proper level of ordinary skill in the art in understanding the P-T diagram, or, alternatively, Hawthorne's patent should be withdrawn for being based on a statement that violates the law of nature (i.e., the P-T diagram).

It would have been obvious to one having ordinary skill in the art at the time of the invention to build an Apparatus for cleaning semiconductor wafers according to limuro's, thereby applying the solvent so as to form a liquid film on the wafer by cooling the wafer temperature, since cooling the wafer temperature is one of the conventional methods to form a liquid phase from the vapor phase.

- Claims 50 and 51 are practically the same as claim 39 in every respect. Claims 50 and 51 are therefore rejected under the same reason and over the same prior art reference(s) as already applied to previously rejected claim 39.
- Claim 48 dependent of claim 39, and claim 52 dependent on claim 51, recite the same limitations as those of claim 46, i.e., adding the recitation of condensing the vapor to form a liquid film by **cooling** the surface of the wafer. Claims 48 and 52 are therefore

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rejected under the same reason and over the same prior art reference(s) as already applied to previously rejected claims 46, 51, and 39.

Specifically regarding claim 48, the limitation of cooling and maintaining the wafer at or below ambient temperature is obvious to one of ordinary skill in the art, as referring to a specific solvent that is in the liquid phase in an ambient pressure corresponding to the P-T diagram of the solvent. The P-T condition to maintain the solvent in liquid form is well-known in the art. This is an Official Notice.

4. Claims 47, 53, and 54 are rejected under 35 U.S.C. 103(a) as being unpatentable over limuro et al. in view of Hawthorne et al.

- Regarding claims 47 and 54, the limitation that the concentration of dissolved gas in the solvent is between about 10% and about 95% by volume, is well-known to one of ordinary skill in the art, as demonstrated in limuro's Fig.1. The fact that limuro's mixture of water/solvent and ozone gas, at an undisclosed concentration ratio, is capable of cleaning the wafer, is an undeniable proof that the proper concentration ratio, as recited in Applicant's claim, is well-known in the art in such a degree, that a specific recitation would have been considered superfluous and unnecessary by limuro et al., as a representative of those having ordinary skill in the art.

Even if Applicant's claimed concentration ratio is somewhat different than limuro's, differences in concentration, temperature, or layer thickness generally will not support the

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patentability of subject matter encompassed by the prior art unless there is evidence indicating such concentration or temperature is critical. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation". *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

- Regarding claim 53, the limitation the film of condensed liquid solvent has a thickness between about 1 micrometer and about 3000 micrometer, is well-known to one of ordinary skill in the art, as demonstrated by Hawthorne et al. in one of the embodiment disclosed in Col.5/ll.29-37. The fact that Hawthorne's film of water/solvent at an undisclosed thickness is capable of cleaning the wafer, is an undeniable proof that the proper thickness range, as recited in Applicant's claim, is well-known in the art in such a degree, that a specific recitation would have been considered superfluous and unnecessary by Hawthorne et al., as a representative of those having ordinary skill in the art.

Even if Applicant's solvent film thickness range is somewhat different than Hawthorne's, differences in layer thickness, concentration, or temperature generally will not support the patentability of subject matter encompassed by the prior art unless there is evidence indicating such film thickness or concentration is critical. "Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the

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optimum or workable ranges by routine experimentation". *In re Aller*, 220 F.2d 454, 456, 105 USPQ 233, 235 (CCPA 1955).

5. Claims 42, 44, 55, and 56 are rejected under 35 U.S.C. 103(a) as being unpatentable over limuro et al. in view of Hawthorne et al., and further in view of Ofuku et al.

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limuro et al. as modified by Hawthorne et al. show all the limitations of claims 42, 44, 55, and 56, as applied to the independent claims 39, 46, 50, and 51, except the limitation that the solvent is applied to the wafer surface directly in liquid form, instead of condensing from a vapor form as in claims 39, 46, 50, and 51. As recited in the Constitution and shown in Fig.1, Ofuku et al. supply a flow of fluid 7 to cover the surface of a semiconductor wafer 3 by means of a nozzle applicator 6. Fluid flow 7 is supplied directly in liquid form as expressly recited in the Constitution, line 6.

It is would have been obvious to one of ordinary skill in the art at the time the invention was made to apply the solvent to the wafer surface directly in liquid form, since application of solvent in liquid form is an equivalent alternative, if not even a simpler alternative, to condensing from a vapor form.

6. Claims 43 and 45 are rejected under 35 U.S.C. 103(a) as being unpatentable over limuro et al. in view of Hawthorne et al., and further in view of Ofuku et al.

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- Claim 43 recites the same limitations as those of claims 48 and 52, except for a dependence on claim 42. Claim 43 is therefore rejected under the same reason and over the same prior art reference(s) as already applied to previously rejected claims 48 and 52, but now with Ofuku et al. as additional prior art previously applied to parent claim 42.
- Claim 45 recites the same limitations as those of claim 40, except for a dependence on claim 44. Claim 43 is therefore rejected under the same reason and over the same prior art reference(s) as already applied to previously rejected claim 40, but now with Ofuku et al. as additional prior art previously applied to parent claim 44.

7. Claim 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over limuro et al. in view of Hawthorne et al., and further in view of Koizumi et al. JP 0 7171519

limuro et al. as modified by Hawthorne et al. show all the limitations of claim 49, as previously applied to the parent claim 39, except the recitation of using specifically perfluorocarbon as solvent.

Koizumi et al. disclose a method of cleaning a semiconductor wafer using ozone gas mixed with a fluorocarbon gas, such as CF_4 and CHF_3 . Fluorocarbon such as CF_4 as well as perfluorocarbon CHF_3 are standard solvents for cleaning purposes used routinely in most laboratories.

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use perfluorocarbon as a substitute for limuro's and/or

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Hawthorne's water as solvent, since perfluorocarbon is known in the art as a standard cleaning solvent even better than water.

Response to Applicant's Arguments

8. Applicant's arguments with respect to claims 39-46 have been considered but are moot in view of the new ground(s) of rejection.

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

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Papers related to this application may be submitted directly to Art Unit 2814 by facsimile transmission. Papers should be faxed to Art Unit 2814 via the Technology Center 2800 fax center located in Crystal Plaza 4, room 4C23. The faxing of such papers must conform with the notice published in the Official Gazette, 1096 OG 30 (15 November 1989).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Bernard E. Souw whose telephone number is (703) 305-3303. The examiner can normally be reached on Monday-Friday from 8:30 am to 5:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudury, can be reached on (703) 306-2794. The fax number for the organization where this application or proceeding is assigned is (703) 308-7722 or -7724.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Technology Center receptionist at (703) 308-0956.

BES

Bernard E. Souw

October 17, 2000

Steven Loke
Primary Examiner

Steven Loke